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EDUCATIONAL DARKNESS AND LUMINOUS RESEARCH[1]

By Dr. OSCAR RIDDLE

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I

ALMOST any group of scholars would agree that during the past fifty to one hundred years research in the natural sciences has provided truth and principles which are capable of transforming earlier and popular views concerning nature and man. Yet, despite the surpassing fruitfulness of this era of research, it may well be that if or when later generations of man should care to form an estimate of our present generation, they will marvel less at this brilliant research than at the depths of our present educational darkness—less at the intellectual achievements of an amazing century of science that has disclosed the basic facts of man's own nature and man's place in nature, than at our present educational programs which essentially fail to give the new truth and principles to this generation. It is in the field of biology—the life-sciences—that this failure is so flagrant and conspicuous; and it is the truth and principles of this same group of sciences that could otherwise contribute so greatly to the mental and physical well-being of the present generation of mankind. These remarks will therefore deal with certain aspects of this flagrant failure of our educational program to comprehend and teach life-science.

In the course of this discussion it may become apparent that the same familiarity with life-science which is required for modern intellectual life, for good citizenship, for progressive agriculture and husbandry, for better health and for preservation against many diseases, will automatically supply that better knowledge which this audience well knows is needed also to save many thousands of lives from cancer.

II

To every one it is evident that only the primary and secondary schools of a nation have opportunity

[1] Luncheon address before the Cancer Forum, Philadelphia, November 30, 1937.

to train the great mass of its people in life-science or in any other subject. These schools form the only broad path to the education of a people. That point is self-evident, but let us briefly examine the recorded comment of a few intellectual leaders who have considered the actual performance of these schools as measured against a background of what is both needed and attainable.

Four years ago Professor Dewey, philosopher and educator, stated as follows:

> We have broken with the intellectual traditions of the past and the mass of men have not had the nature of the change interpreted to them. . . . The field of education is immense and it has hardly been touched by the application of science. There are, indeed, courses in science installed in high schools and colleges. . . . But the scientific attitude, the will to use scientific method and the equipment necessary to put the will into effect, is still, speaking for the mass of people, inchoate and unformed. The obligations incumbent upon science can not be met until its representatives cease to be contented with having a multiplicity of courses in various sciences represented in the schools, and devote even more energy than was spent in getting a place for science in the curriculum to seeing to it that the sciences which are taught are themselves more concerned about creating a certain mental attitude than they are about purveying a fixed body of information, or about preparing a small number of persons for the further specialized pursuit of some particular science.
>
> There is, moreover, a virgin field practically untouched by the influence of science. Elementary education is still a place for acquiring skills and passively absorbing facts. It is generally now admitted that the most fundamental attitudes are formed in childhood, many of them in the early years. The greatest indictment that can be brought against present civilization, in its intellectual phase, is that so little attention is given to instilling, as a part of organic habit, trust in intelligence and eager interest in its active manifestation . . . (and) to the formation of the inquiring mind that explores and tests.

From President Hutchins, trained in law and administration, we quote the following:

> However diversified the curriculum below the junior year of college may be, the core must be a good general education. We know that such a thing does not exist to-day. What we find instead is a series of short unrelated courses comprising a smattering of miscellaneous facts, which leaves the student uneducated and, except perhaps in the spasmodic exercises of memory, untrained.

The writer Joad has well said:

> One of the most disquieting facts about modern civilization is the failure of our social wisdom to keep pace with our material power. Science has equipped us with powers fit for the gods, and we bring to their use the mentality of babes and schoolboys.

A few days ago Dr. F. R. Moulton, the mathematician and astronomer, said: "If science is to be made to realize its possibilities in the advance of civilization, then it must become an essential part of the intellectual life of the average man, for in the long run the masses determine the rate of progress." On the same day Professor Hooton, the anthropologist, stated: "I believe that the application of biological science to man is the single means of salvation of our species."

Finally, we recall some words of Charles W. Eliot, a chemist, who was long president of Harvard and America's great educational leader. "The human race has more and greater benefits to expect from the successful cultivation of the sciences which deal with living things than from all the other sciences put together."

You are thus given some evidence that present failure of our secondary schools to educate in satisfactory degree is recognized by many of those who are competent to pass judgment. Also, the high value of the life-sciences as a *means* of education, and the unique importance to human welfare of wide-spread familiarity with the principles of life-science, are things now accepted by some competent judges who are themselves not biologists.

III

Later in this statement we shall indicate that in this country instruction in life-science has deteriorated rather than advanced during the past third of a century—that is, instruction has regressed during the precise period when research has brought us the most of clarifying knowledge concerning ourselves and the living world. Before elaborating that point, however, I ask several minutes for placing before you some samples of the truths and principles of life-science which our schools could teach most of our educable children if life-science were given a continuous four-year place in the curriculum of our secondary schools. With that done, you yourselves are further asked to judge whether these samples are or are not well adapted "to kindle power and understanding in immature minds"; whether likely or unlikely to give "familiarity with the scientific method, and the will to use the scientific method"; whether they fail either to indicate or to clarify our "break with the intellectual traditions of the past"; and whether they can serve "to form the inquiring mind that explores and tests"; whether indeed, they are not essential for good citizenship and for anything that may to-day be rightly considered a decent education.

A good course of study in life-science would begin with the earth as a burning fragment of the sun. And its early chapters would deal with the physical results of the cooling of this fragment. In the super-heated gases of the new-born earth only a *few* chemical com-

pounds could possibly exist and present knowledge of the sun gives the clue to their identity. With progressive cooling of the little sun which became the earth more and more chemical compounds *must* form, and important parts of that story are at hand. When cooling progressed to a stage at which water could exist in the liquid state an inevitable and almost limitless series of new compounds *must* have begun to form. Many of these compounds are identifiable; and they are found to include some quite simple *organic* compounds which had to enter into the first living matter and which still continue to sustain it. Obviously, some simple facts from astronomy, physics, chemistry and geology have a share in the subject-matter of life-science.

Next, the findings of paleontology would place minute and lowest forms of life as the first to appear on the earth; and that science would supply still other superb chapters of the history of life. Later and adequate biological consideration of selected types of living things, from virus and bacteria to man, would provide the background against which the principle of continuity, and of change dependent upon *natural law*, may be seen to reach from sun to man.

The early part of such a course of study would seem capable of giving our youth an *orientation toward nature* which corresponds with what modern research has disclosed. The latter and much more time-consuming phase of this effort at education would relate to *the nature of living things and of man himself* and so prepare him to live comprehendingly among other men. Of some of these many and specific things concerning man and the living world I wish now to speak.

Life-science can present the basic facts concerning the great principle of organic evolution. The gradual origin by descent with modification of complex life, including man himself, and the kinship of all living things, are blended in this preeminent principle. The outlines of the rules and laws of that progress may and should become the common denominator of all thought about life. In the center of this great stream of life we discover the principle of progress deep within ourselves; and, as a crowning fact, we observe that of nearly two million living species it is mankind that has been lifted most—and mankind that is now the moving point—on the wave of life.

Life-science presents the broad and humanly momentous principles of inheritance: How and why the offspring find repeated in themselves the characteristics of their ancestors; knowledge and understanding of differences or variation among offspring; the utilization of these principles in the improvement of races of animals and plants upon which human existence depends; and finally, the full realization that on the basis of their heredity no two human beings, excepting identical twins, are exactly equal. So significant are these well-established principles, that we ask: For how long and to what extent dare communities, and their ever more complicated social and legal regulations, disregard the basic fact of the biological *in*equalities of men?

Life-science now presents the inspiring facts of the plasticity or modifiability of the growing organism, even though initial hereditary inequalities can never be wholly or permanently erased. In much the same way, and using some of the same tools, by which life-science has obtained control over many diseases it has now made substantial beginnings in controlling the growth and attainments of plants, animals and of man himself. Best of all, these and hundreds of kindred things are things always repeatable under the prescribed conditions—they are in no way at the caprice of magic or of wishful thinking. What a world of wealth and inspiration is this to the unspoiled youth—the future citizen—who thus learns of man's fast-growing power over even his own destiny!

Life-science—thanks to laboratory triumphs for almost each one of the last twenty years—now presents a handful of vitamins with which any youth may cure certain diseases; and better still with these he can assure himself freedom from these diseases. This simply statable knowledge is needed by all, and all of it is particularly useful to the young.

Life-science can give acquaintance with our own bodies, with the functions of our various organs, with the natural and artificial enemies of these organs, and with the conditions essential for health. Having interest in and familiarity with our own bodies and minds each individual would thereafter become the quite special and unique protector of his health and well-being in situations that attend all the days of his life. It is not negligible that this knowledge would curtail the quacks. Of much importance too is the circumstance that, if all our secondary school graduates obtained the thorough grounding in all aspects of life-science contemplated here, the public press of the country might soon become a real adjunct to the continuing education of our people in science beyond their days in school. That service will develop only if and when interest and understanding develop in the public that buys and reads the daily newspaper.

Life-science provides the natural and best opportunity of introducing those facts concerning reproduction and sex which are necessary for youth at or before the high-school age. We all know that many parents do not supply this expedient information and that the personal welfare of many is adversely affected by a protracted ignorance of this somewhat difficult and delicate subject.

Life-science presents the ever-present and pervasive

fact of the struggle for existence with the consequent elimination of the unfit. The young citizen will learn that in our civilized communities the harsher aspects of that struggle are not present; that the individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. He will know that this must have profound effects upon the future of man. He will find much food for fruitful thought in the dilemma that, unless we develop and use a quite possible and far-reaching control over human reproduction and development, our high civilization will itself lead to the deterioration of the race; and that this retrogression—already in evidence—renders the individual correspondingly more and more dependent upon the community for his welfare. He will thus become familiar with basic facts against which he may judge proposed laws dealing with social change.

Life-science attends and discloses the halting steps of primitive man. That man required many thousands of years for learning to make a most simple tool—a flint for aid in obtaining food and in subduing wild animals; and for hundreds of thousands of years thereafter that paleolithic man seems to have made little or no further progress, and probably his successors built their first city only during the last 15,000 or 20,000 years. That long drab epoch of human futility provides a full and brutal demonstration of binding limitations of raw untutored man. And no citizen who is unaware of the lame march of early man and the lifting power of a few tools and discoveries has even begun to comprehend either the human species or the social and political forms under which modern men may hope to live together.

Life-science can present the drama of life as this was performed in a very restricted zone—quite near to the very surface of our small planet. Even bacteria disappear in the upper reaches of the atmosphere, and other life extends downward only to the limits set by the ocean depths. At no earlier time in the earth's history has this been different. Fossil remains of living things are found in coal and rock strata now some thousands of feet beneath the soil on which we walk, but it is clear that these veins were land surfaces or ocean floors when they trapped the dead bodies of organisms. If, in an Arabian Night's excursion, we might look at the present living world from afar—say, from the 24,000 miles which is one tenth of the distance to the moon—we could rightly sense the narrow pinions of life. Then, on the great sphere which would nearly fill our view to east or west, we should see all life imprisoned in a thin film—a living skin—tightly fitted to the very surface of the earth. As we now know it, the entire story of life sticks to the place where there is liquid water, with earthly salts dissolved in it; where gaseous oxygen, carbon dioxide and nitrogen abound; and where surfaces can absorb sunlight for a continuous flow of free energy. Life thus presents itself as the most circumscribed and contingent thing in a world of things; and it seems to be the newest thing in the universe.

Life-science can emphasize the newness of intimate knowledge of ourselves. Nearly all the definite and worth-while that we know about our own bodies has been learned within the time of men now alive. Most that we know about the care of our bodies and nearly everything that we know about fighting disease successfully has been learned in that same time or in an even shorter period. The whole range of diseases based on bacteria and viruses are things new to this period. The science of nutrition is new. The science of anthropology is new. The real science of psychology is new. So it is with practically all other aspects of this subject. In the life-sciences the new evidence has come that life itself was evolved from the non-living; that one living species is slowly transmuted into others; and that all life phenomena, from the division of a bacterium to the consciousness of man, have evolved under natural law. As a result of these extensions of knowledge the intellectual life of some men of the present generation is a variety hitherto unshared with any former generation of man. It is, and has been, the great educational opportunity of to-day and yesterday to bring this intellectual climate to the many who come for education to our secondary schools. And who will doubt that future beehive aggregations of men may be wrecked if the ever-multiplied rules and laws under which they are forced to live are based upon variegated tradition instead of upon a common body of knowledge?

We have taken some pains to say that there is no lack of a body of knowledge especially adapted to real education at the high-school level; and that, fortunately, this same body of knowledge provides a firm basis for a comprehending citizenship.

Against this background of achievements of recent illuminating research we may nevertheless witness a deterioration rather than an advance in secondary school instruction in biological or life-science during the past thirty or thirty-five years. Even in that earlier period life-science grudgingly held a very subordinate place in the secondary schools of the United States; but my own examination of this question leads to the conclusion that less biology per high-school pupil is taught to-day than was taught a third of a century ago. I have earlier and elsewhere presented some of the evidence for this conclusion, and can cite no more than a trace of such evidence here. The purpose of this address is to prompt this group of interested citizens to awareness that one to three genera-

tions of luminous research are now in eclipse; that laboratory conquests bringing life and light to man are now submerged in an educational darkness that is shameful and unworthy of our day; and that heavy obligation and duty rests upon us all to identify and oppose those forces which now prevent an oncoming generation from possessing this rich inheritance.

In commuting to my laboratory each day I pass through a typical Long Island town whose public high school enrolls about six hundred pupils. This school has forty-three teachers, and of these *two* are teachers of science! That is, two of these forty-three teach whatever is taught of chemistry, physics, astronomy, earth science and life-science. Two of the forty-three teach whatever is taught about the human body and mind, its care, defenses and diseases; whatever is taught about the living plants and animals from which we sprang, from which we must ever be sustained and with which man must always remain in balance; whatever is taught in their six-year high-school period about the earth, air, water and sunlight that built life and man; whatever is taught of the sciences which are the sustaining parents of the technologies—engineering, medicine, forestry, agriculture, husbandry and the rest; yes, upon these two of the forty-three rests whatever is taught about those physical, chemical and biological laws and forces—outside and inside of man—that supply mankind with its just hope for grandeur and power and happiness, and with its rational estimate of the limitations of man and of the origin and destiny of man.

Less than 5 per cent. of the effort of these forty-three guides in secondary education is given to these many supreme things. At this moment about one sixth of the pupils of this school are giving about one fifth of their school effort to "general science," and sometime late this winter or next spring this course being studied by one sixth of the pupils will become concerned with bits of elementary biology. Meanwhile, and at this moment, only thirty-five pupils in this school are in fact given opportunity to devote a fragment of their time to the study of biology as an elective subject.

But the degree of intellectual sterility and the prevalence of abortive educational practice in our secondary schools become still more emphatic when it is found that in most such schools the biology that is taught must first be emasculated either by veiling or by excluding the principle of evolution—which is the core and center of biological thought. Though this preeminent principle pervades the whole of life-science and constitutes its most superb intellectual achievements, both teacher and text-book are often or usually forced by prevailing prejudice to place only a pale ghost of our science in the student's hands. During the past seventeen years five states (if we include Utah) have passed laws which prohibit the teaching of evolution in their public schools. The sentiment which wrote these laws is widely prevalent everywhere; and we would be both blind and asleep if we failed to recognize that this sentiment receives its chief support from the traditional religion of this and earlier days. There is to-day no country under the sun where the prevailing religion—be it Buddhist, Mohammedan, Shinto, Pagan, Christian or Hebrew—does not resist the compelling facts, and clear implications of the facts, that modern research has disclosed concerning the origin of life and man under natural law. If the best of life-science is to become a possession of our people, thinking men and women must free our schools from that paralyzing restraint and see to it that the course of our civilization is guided by knowledge rather than by tradition and the dead hands of the past.

Perhaps you who live in and near Philadelphia imagine that the bit of life-science taught in your schools is *real* biology, and that here the heavy hands of tradition have not restricted the teaching of the evolution principle—the central principle of our science. The following quotation from the *Philadelphia Evening Bulletin* of August 13, 1937, and not corrected in immediately following issues of that newspaper, indicates that the biology taught here in Philadelphia is of the bloodless and ghostly type so commonly taught elsewhere in the high schools of this country. The principal of one of your most honored high schools is there quoted as saying:

> The old theory of evolutionists as to whether man is descended from the monkey has been over these many years. Such teaching is discredited and is not representative of science and so will not be found in our text-books.
>
> The public schools teach biology. In this study, the difference of the species is indicated.
>
> The difficulty in teaching science often has been that it has been approached with an irreligious attitude. There is no such attitude among the public school teachers of Philadelphia.
>
> This old controversy is a recurrent thing among laymen but in science it has been generally discredited and is not representative of science.

Thus, in this Philadelphia high school one notes no hesitation in plumping both the baby and the bath out of the educational window. One can only wonder how a biology that has thus been robbed of its viscera and brain may be expected to sustain intellectual effort—and educate. Perhaps we should also wonder whether those engaged in secondary education of this type seriously expect—from any or all subjects they teach—to "form the inquiring mind that explores and

tests" which Professor Dewey has noted as the valid aim of public education.

We thus approach a second restrictive influence on the teaching of life-science to our people. There is wide-spread failure of educators and public-school administrators to recognize and to utilize the great intellectual achievements of this scientific age. Even the most favored type of training for leadership in public education seems in recent decades to have slipped away from substantial backgrounds of knowledge into protracted tests and dissertations on methods of teaching. Educators with an outlook thus narrowed and distorted must be held largely responsible for a growing number of state laws and regulations which now often practically limit teaching licenses in high-school subjects to those who are surfeited with drill and doctrine on *how* to teach, but who are largely bankrupt in the subject-matter which must be taught.

During the past eighteen months I have been a member of a committee which is actively investigating the many things which affect the teaching of biology in our schools. From this source and from others there is no lack of evidence that laws and state board requirements of the type just indicated adversely affect the teaching of all science subjects in our high schools. It could be said with fair safety and certainty that in some states the promotion of such laws and regulations by our educational leadership is now preventing most of their prospective teachers of biology from obtaining an acceptable training in biological science. Here, then, is a second aspect of harmful restraint in public education upon which an aroused interest of thinking citizens is greatly needed.

IV

In conclusion, let us recall that in these and coming days the principle of democracy is itself under destructive pressure. Shall the public that decides the fate of our democracy conceive nature and man as research discloses them, or as uninformed and essentially ignorant masses can variously imagine them? In some laboratories of the world—chiefly in Europe and America—the researches of much less than a century have shown that such things as mosquitoes, flies and lice may and do carry pain, disease and death—and poverty—to human beings. Enlightened thought and practice in some parts of the world now strive to exterminate such carriers of pain, poverty and death, and thus to advance civilization on a basis of reality; but only two years ago last June Mahatma Gandhi—who alone largely controls the destiny of one eighth of mankind—seems to have said: "We have no right to take the lives of mosquitoes, flies, lice, rats or fleas. They have as much right to live as we." The Gandhis are everywhere—they are your neighbors and mine—and they thrive and propagate in a dim educational twilight from which the thought-transforming light of new knowledge is essentially excluded. To-day nations and peoples have a choice: on the one hand, between the host of unrealities, poverties and diseases rooted in meditations, crystal-gazing and traditional ignorance; on the other hand, through full and earnest public education their destiny can accord with the realities already disclosed by much and luminous research.

RESEARCH AT MELLON INSTITUTE DURING 1937-38

By Dr. W. A. HAMOR

MELLON INSTITUTE, PITTSBURGH, PENNSYLVANIA

THE scientific work of Mellon Institute during the fiscal year, March 1, 1937, to March 1, 1938, is described in the annual report of the director, Dr. E. R. Weidlein, to the board of trustees, which has just been published. During this period the institute's investigations in pure science were expanded, especially in the fields of biology and medicine, and the research programs of the industrial fellowships were also widened. Throughout the year $1,062,830 was expended by the institution in conducting pure and applied science research.

Hydroxyethylapocupreine, a contribution of the institute's department of research in pure chemistry, has aroused great interest as a possibly useful drug in the treatment of pneumonia, and hence has been given broad collaborative study by the chemical, pharmacological and medical staffs connected with the problem of pneumonia therapy. Drs. C. L. Butler and B. L. Souther and Misses Mary Hostler and Mary Clapp were active in the preparation work; and in order to facilitate further the production of the drug for more extensive clinical trial, semi-plant scale operations were undertaken by E. R. Mease. Medical work on hydroxyethylapocupreine also advanced during the year through the study of additional clinical pneumonia and pneumococcic empyema cases and through the testing of new experimental drugs prepared in the institute (Drs. W. W. G. Maclachlan, J. M. Johnston, H. H. Permar, M. M. Bracken and G. E. Crum; Professor W. T. Dawson). Supplemental clinical studies on children are being carried on by Drs. Maud Menten and R. R. Macdonald. Research on alkyl, hydroxy-

alkyl and other derivatives of apocupreine, with the aim of finding more efficient antipneumococcic drugs, is being pursued productively by Dr. Alice G. Renfrew and assistants, working under the direction of Dr. L. H. Cretcher, the departmental head.

Studies on the revision of texts for the U. S. Pharmacopoeia have been continued in this department by Dr. M. W. Green, under the guidance of Dr. G. D. Beal. Also of concern to pharmaceutical and medical specialists has been the research of the demulcent fellowship (1934–36) on the employment of certain bassorin gums in the treatment of intestinal complaints of bacterial origin. At present clinical studies are being made thereon at a prominent medical school under a grant by the institute. The basic medical researches sustained since 1928 by the institute at the Western Pennsylvania Hospital in Pittsburgh have in general pertained to bacteriological and serological problems. These investigations, inspired by Dr. C. B. Schildecker, are being carried on by Dr. R. R. Mellon, aided by five scientists and five assistants. In 1937 this group continued studies of the treatment of streptococcal and pneumococcal infections. The research pertaining to the variability of the tubercle bacillus has reached the point where it appears to be of some importance in diagnosing anomalous aspects of lung tuberculosis while they are still in their benign stages. This advance may make it possible to resort to preventive and hygienic measures that should stop these stages from passing into the classical and more fatal forms of the disease. A number of medical schools have been supplied with samples of the special diagnostic tuberculin for experimental purposes.

The institute's nutrition fellowship, a pure science investigation headed by Dr. G. J. Cox, assisted by Misses Sara F. Dixon and Margaret C. Matuschak and by Edgar Walker, is supported by The Buhl Foundation of Pittsburgh to study broadly the causes of dental caries. Three phases of the nutritional influences in caries etiology are receiving research, namely: (1) nutrition during the period of formation of the teeth, (2) foods which initiate caries, and (3) factors which affect the rate of progress of decay. In a study of the first of these phases, it has been shown that modification of the diet of female rats during pregnancy and lactation affects the caries susceptibility of the young. The best improvement obtained so far has been the elimination of three out of four cavities of the type studied by the fellowship, indicating that nutrition plays a part in the formation of caries-resistant teeth. Studies of the formative phase of teeth and their ultimate resistance to caries are concerned with (1) protein, (2) the influence of the ratio of calcium and phosphorus in the diet of the mother, and (3) the effects of fluorides added to a diet containing a minimum of fluorine. Tests of the concept that certain properties of foods initiate caries, as distinct from their action in promoting the carious process following the inception of decay, are under way. One of these studies is of the effect of thermal shock in inducing caries in rats. Another investigation has to do with the comparison of the number of cavities produced in rats by thoroughly dried corn meal and meal softened by exposure to 100 per cent. humidity. Proof that foods promoting decay do not necessarily initiate cavitation is provided by the demonstration that fermentable carbohydrates will not start dental caries in rats but will accelerate decay in existing cavities. A current study of a metabolic influence on rate of decay of teeth has to do with experimental acidosis produced by ammonium chloride incorporated in the diets of rats with existing caries.

Seventy-two applied science research programs or industrial fellowships—34 multiple and 38 individual fellowships—were in operation during 1937–38. These investigations required the services of 142 fellows and 76 fellowship assistants during all or part of the year. Through their accomplishments many fellowships have assured their continuity. Thirty-seven fellowships have been at work for 5 years or more, and of this number 18 have been active for 10 years, 11 have concluded 15 years or more of research, and 8 fellowships are 20 years of age or older. Seven fellowships began operation during 1937–38: amine, Anthracite Industries, chemical hygiene, Cotton Foundation, dielectrics, protein, and tar properties. The can investigation, a multiple fellowship, resumed work with new personnel after a pause in operation. The institute has accepted five new fellowships whose research will be started soon. The following fellowships concluded their investigations in 1937–38: air pollution research, a special survey that was a part of the Air Hygiene Foundation work; anthracite, which was succeeded by the Anthracite Industries fellowship; bone products, which was consolidated with the bone black fellowship; and detergent.

The achievements of the fellows during the year have demonstrated the value of the facilities in the institute's new building, occupied early in 1937 and dedicated last May. The new home has not only supplied adequate space, equipment and special research quarters, but has also given rise to a new enthusiasm and a greater desire on the part of the fellows to be successful in their work. The year 1937–38 was in fact characterized by unprecedented advances through industrial fellowship researches, principally a number of new products of promise. Releasable facts regarding this investigational progress will now be summarized.

Air Hygiene Foundation of America, Inc., a coop-

erative organization with headquarters and a multiple fellowship at the institute, made valuable additions to the improvement of industrial health by attention to the medical, engineering and legal phases of the problems involved. H. B. Meller, the senior fellow, is managing director of the foundation, which is supported by 200 industrial concerns. Scientific investigations were begun by the foundation at the Saranac Laboratory and at the Moore School X-Ray Laboratory of the University of Pennsylvania. These researches seek the development of practical procedures now needed to aid industries in the prevention of occupational diseases. Engineering studies have been arranged for at the Harvard School of Public Health. The foundation's legal committee has studied and reported on compensation legislation. The foundation reviews and abstracts current literature relating to industrial hygiene, conducts short-time studies for members, and acts as a central clearing-house for information in this rapidly developing field. The institute's chemical hygiene fellowship, of which Dr. H. F. Smyth, Jr., is the incumbent, with two assistants, is studying the toxicology of some of the newer synthetic organic compounds.

Dr. H. J. Rose and his associates on the Anthracite Industries fellowship are designing basements and utility room layouts for residences in relation to modern automatic anthracite heating installations. Engineering data relating to the performance of anthracite fuel beds and to the design of heating equipment are being systematically gathered and studied. The fellowship is also devoting attention to possible uses for anthracite ashes.

Within the past two years Dr. F. J. Williams on the lead fellowship has evolved a new process for manufacturing barium oxide from barium sulfate. The multiple fellowship on calgonizing, guided by Dr. B. H. Gilmore, has pursued its investigations of the sanitary value of sodium metaphosphate in machine dishwashing and of the uses of sodium metaphosphate products containing soap. The ceramic chemicals fellowship, held by W. J. Baldwin, has had successful results in researches on wet-process enamels.

The multiple fellowship on commodity standards, headed by Dr. Jules Labarthe, Jr., has a basic program placing particular emphasis on the establishment of standards for nearly 300 items of staple merchandise for the purpose of providing known values for consumers. The fellowship staff is also active in consumer education. The multiple fellowship of the Cotton Research Foundation, whose incumbents are Drs. D. M. Musser, R. F. Nickerson and H. S. Olcott, is investigating in general the chemical and physical properties and uses of the whole cotton plant. The Cotton Research Foundation is a group of private individuals who have perceived the needs of the industry in its entirety and are cooperating in an effort to improve its status. Through the fellowship this group has turned to scientific investigation as a means of finding new uses and new markets for cotton and cotton products and of safeguarding present markets in which cotton has encountered serious competition. The activities of the multiple fellowship on garments (Dr. T. H. Swan, senior fellow) is concentrating on problems related to the production and wear of men's shirts, neckties and undergarments.

Dr. R. N. Wenzel on the dielectrics fellowship has for his objective the development of improved insulating materials and processes for application to electrical equipment. The multiple fellowship on heat insulation, supervised by R. H. Heilman, has continued conductivity determinations, especially in the low-temperature or building insulation field. A broad research has been conducted on rock-wool products. The fellowship has also aided materially in the development of technical information on a new all-asbestos insulating air duct, a product of importance in air-conditioning. On the safety fuse fellowship D. E. Pearsall developed, as a result of continued investigation on the improvement of safety fuse blasting, a series of new slow-burning fuse powders. This fellowship has also worked out a new non-smouldering type of safety fuse that has an almost fireproof structure.

L. C. Hewitt on the silicate fellowship has created a new block for glass tanks. The multiple fellowship on mineral products, headed by Dr. G. J. Bair, has devised a process of preparing an exceedingly fine silica with unique properties. The multiple fellowship on technical glass (Dr. R. R. McGregor, senior fellow) has centered research attention on problems of cementing and caulking of glass tile and glass block. Recent developments of the multiple fellowship on refractories (S. M. Phelps, senior fellow) have to do with learning about the properties of insulating fire brick, plastic refractories, cold-set cements and the spalling of silica brick. During the year Dr. E. E. Marbaker on another fellowship has continued studies of special ceramic constructional materials for laboratories.

On the paper fellowship, Dr. P. B. Davidson carried out research that resulted in a new blueprint paper. Dr. G. H. Young and his aids on the multiple fellowship on protective coatings added usefully to the knowledge of the fundamental structure and properties of organic resin films on metals. A new resin ("Raolin") is under development by J. W. Raynolds and his coworkers on another multiple fellowship. Sulfur cements are being applied in new ways found by Dr. P. V. McKinney and the other incumbents of the multiple fellowship on sulfur.

The multiple fellowship on organic synthesis, whose senior fellow is H. F. Robertson, carried forward studies on the preparation, properties and uses of amines, solvents, intermediates and resins. In the field of amines, various derivatives of alkylene, alkylol and heterocyclic amines were made and their characteristics and some of their applications investigated. Work on solvents consisted partly of the preparation of new propylene glycol and ethylene-propylene glycol derivatives that have not heretofore been available for research. An investigation was made of the solubility of all the commonly available natural gums and resins in over 40 solvents, and a study was carried out on the corrosive effect of commercial chlorinated solvents on metals. Work on brake fluids was continued, as were experiments on water-soluble textile lubricants. Several new products were synthesized, among them the silicon and titanium esters of some higher alcohols as well as their phosphoric and boric acid esters. Advances were recorded in research on problems incidental to the refining of lubricating oils by solvent extraction methods. A number of newer compounds of interest to the dyestuff and pharmaceutical industries were synthesized. Investigation was continued on the properties of the sodium sulfates of some higher alcohols, three of which are now on the market under the name of "Tergitol" penetrants. In the domain of resins experimental work was carried out on the improvement of vinyl resins in hot-melts for those adhesive applications where the use of solvents is undesirable. Facilities were provided for adapting some of the commercially available vinyl resins to the specific needs of the protective coatings industry.

During the calendar year 1937, one book, 14 bulletins, 32 research reports and 65 other papers were published. Twenty-two United States patents and 70 foreign patents on fellowship discoveries proceeded to issue. The total contributions to the literature for the 27 years ended December 31, 1937, have been 20 books, 157 bulletins, 776 research papers and 1,182 miscellaneous papers; 690 United States patents were granted during the same period.

SCIENTIFIC EVENTS

BUREAU FOR STREET TRAFFIC RESEARCH AT YALE UNIVERSITY

YALE UNIVERSITY has announced the establishment, beginning on July 1, of a Bureau for Street Traffic Research to be devoted to the joint purpose of the scientific study of the problem of street and highway traffic accidents and congestion and to the training of graduate students for professional work in the field of traffic engineering.

President Charles Seymour, in making the announcement said:

This action on the part of Yale University is in line with its long interest in the entire field of efficient transportation. Through the Transportation Committee now composed of Professor Charles Tilden, Robbins Stoeckel and Dean S. W. Dudley, Yale University has for many years, with the aid of funds bequeathed by Lord Strathcona, conducted broad studies of the problems of transportation.

The function of transportation has always been a factor of great social and economic importance. In the present generation it has assumed new importance and has accumulated additional problems in the almost universal use of the automobile.

With 29,000,000 motor vehicles in operation by 40,000,000 drivers over a 3,000,000-mile highway system, the automobile has become the dominant transportation mechanism in America. Despite the many obvious services which it has rendered to society, it has, nevertheless, brought with it some exceedingly serious and complicated problems. These problems fall into two natural categories: those of accidents and those of congestion. America can not calmly accept a situation where 40,000 lives are taken annually through accidents, many of which are obviously preventable, nor can the country accept without serious question a situation where congestion deprives a valuable transportation service of its maximum efficiency.

There is a further need at this time to make a searching examination of the possibilities of achieving a better coordination as between the various means of transportation available to the American people. In line with its traditional policy of attempting to render full service to society through the development of techniques to solve current social problems, Yale University has taken the step of establishing a formal activity devoted to the development of engineering and administrative principles for the relief of the joint problem of traffic accidents and traffic congestion.

Provision will be made for continuous research on problems in this field and, in addition, for the training of qualified graduate students for professional positions in the field of traffic engineering. Beginning with the academic year 1938, there will be available twenty-three graduate fellowships, fifteen of which are provided by a general grant of the Automotive Safety Foundation and eight of which are provided through a grant made by Alfred P. Sloan, Jr. The major financial support for the bureau will be through the Automotive Safety Foundation and its president, Paul G. Hoffman. Intensive training will be given covering the entire field of traffic engineering and administration. The staff of the bureau is composed of Miller McClintock, Maxwell Halsey,

T. M. Matson and Theodore Forbes. They have been prominently identified with the development of the growing profession of traffic engineering, both in research and training activities and, likewise, in professional engineering work.

EXPANSION OF THE TUFTS MEDICAL SCHOOL

ACCORDING to an account given in *The Tufts College Alumni Bulletin*, approval was given at a recent meeting of the Board of Trustees to the proposal of the Executive Council of the Medical School Alumni Association to raise a fund of $2,000,000 for building an entirely new medical school as a physical part of the New England Medical Center on Bennet Street, downtown Boston. The new school will replace the antiquated buildings on Huntington Avenue.

This fund is to be raised by appeal among the alumni, their friends and among the general public. Part of the money will be utilized for building the new school; the balance will go into endowment for improving the teaching facilities and for a much-needed surgical teaching unit.

For Tufts Medical School, this move means greatly added prestige. In 1929 the school associated itself with the Boston Dispensary and the Boston Floating Hospital in forming the New England Medical Center. To this group is now being added the Joseph H. Pratt Diagnostic Hospital.

Plans for the improvement of the Medical School were formulated by the late President Cousens and the Medical Alumni Association more than a year ago. These plans at first contemplated the raising of $250,000 only among the alumni. Discussion led to the decision that the needs of the school were much greater and a public campaign was decided upon.

The *Bulletin* points out that:

> The close control of medical education by the American Medical Association has forced medical schools all over the country to elevate their standards both with regard to physical equipment and to the teacher-student ratio. The school has always had a Class "A" rating, but the pressure to meet requirements of the American Medical Association has been growing. The main building on Huntington Avenue has been used since the beginning of the century and it is entirely inadequate for present-day needs. To increase the teacher-student ratio means the creation of new professorships and the only solution is sufficient endowment to meet this need. At the Medical Center, the teaching of surgery has been handicapped because of the lack of a surgical unit.
>
> Plans for the medical school, therefore, finally crystallized into a campaign to raise $2,000,000. Of this sum, $150,000 will go to a surgical unit, from $750,000 to $850,000 for a new school building at the Medical Center, and $1,000,000 to set up an endowment sufficient to meet present teaching needs.

THE AMERICAN STANDARDS ASSOCIATION

REPRESENTATIVES of ten national associations met on April 6 at the offices of the American Standards Association to set up standard methods and procedures for the guidance of testing laboratories and other public endorsement agencies.

Need for this action arises from the increasing use by producers and distributors of "approvals" "certifications" and "listings" to satisfy the consumer demand for more factual information concerning quality of goods and performance of equipment offered for sale. These "certifications" are of great potential value to the buying public if backed by adequate tests of responsible agencies; but, according to the Association of Consulting Chemists and Chemical Engineers who proposed that the American Standards Association undertake this work, such tests are not always carried out. It is pointed out that "Irresponsible endorsements that claim significance which they do not possess are bringing the whole system into disrepute. Some vendors cater to the consumer desire for facts by asserting half-truths or by implications which have no real significance. In other cases there is no evidence of the existence of standards, and if they do exist they are not available to the public. Some vendors use 'certified' as a trade designation."

The proposal of the testing engineers and chemists, many of whom are heads of laboratories, has been heartily endorsed by the National Bureau of Standards, the National Association of Purchasing Agents, the American Home Economics Association, the Consumers' Division of the U. S. Department of Labor and the American Society for Testing Materials.

The plan is to set up standard practices covering fundamentals which should underlie approval procedures—such standards to be developed cooperatively by consumers, producers, distributors and advertisers, many of whom were represented at the meeting. Among the points suggested for inclusion are a clear statement of the auspices under which any plan of approval is operated; adequate independent sampling and testing of the product to determine its conformity with definite, published standards; systematic reexamination to insure continuing conformity, records of tests to be publicly available, and compliance with these principles to be indicated on labels or tags.

At the meeting, Thomas A. Wright, of the Association of Consulting Chemists and Chemical Engineers, was appointed chairman and B. L. Oser, secretary.

The following organizations were represented at the meeting:

American Society for Testing Materials
American Home Economics Association
American Council of Commercial Laboratories
National Association of Purchasing Agents

Consumers' Project, U. S. Department of Labor
National Bureau of Standards
Association of Consulting Chemists and Chemical Engineers
National Electrical Manufacturers Association
National Retail Dry Goods Association
National Federation of Textiles

THE OTTAWA MEETING OF THE SOCIETY OF CHEMICAL INDUSTRY

THE annual meeting of the Society of Chemical Industry will be held at Ottawa from June 20 to 24, in conjunction with the twenty-first Canadian Chemical Convention. *Industrial and Engineering Chemistry* reports that a large party of British chemists, including representatives of government technical departments, professors and industrialists, headed by Lord Leverhulme, governor of Lever Brothers, Ltd., and of Uni-Lever, Ltd., will visit Canada on this occasion and will be joined by chemists from the United States. Canadian chemists from all parts of the Dominion will be the hosts of the British and American visitors.

Other prominent British visitors will be J. Davidson Pratt, general manager of the Association of British Chemical Manufacturers; L. Jordan, director of the British Paint Research Laboratories; Foster Sproxton, an authority on plastics, who will deliver the Jubilee Memorial lecture on June 20; L. H. Lampitt, chief chemist of Messrs. Lyons, and W. A. S. Calder, a director of Imperial Chemical Industries.

Technical sessions will be held each morning. Visits to plants and to places of interest around Ottawa and various social functions complete the program. Dr. L. H. Baekeland will be the recipient of the Messel Medal, and Dr. Marston T. Bogert, of Columbia University, will deliver an address. On the twenty-first there will be a symposium on "The Utilization of Canada's Natural Resources through Chemical Research," at which several prominent industrialists and chemists will present summaries of the great advances made in the last ten years in the production of chemicals and related products derived from Canadian fields, forests, mines and water powers. Papers dealing with road and building materials, foods, industrial and chemical engineering developments will be presented at sectional meetings on June 22, as well as accounts of the latest research in pure chemistry and biochemistry in Canada.

From Quebec, where the British party is to land on June 17, the visitors will proceed to Shawinigan Falls and then to Ottawa. After the meeting, the party will visit Sudbury, Toronto, Port Hope, Kingston, Hamilton and Niagara Falls, where they will be entertained by the American section of the society. From Niagara Falls, they travel to Montreal, spending three days inspecting places of scenic and technical interest in the neighborhood, before returning to Great Britain on July 1.

The members of the American Section of the Committee on Arrangements for the Niagara Falls visit include: Frank J. Tone, of Niagara Falls, *chairman,* James G. Vail, Wallace P. Cohoe, C. S. Kimball and J. W. H. Randall.

THE AMERICAN COMMITTEE FOR INTERNATIONAL WILD LIFE PROTECTION

THE American Committee for International Wild Life Protection, which for seven years has had office space in the Museum of Comparative Zoology in Cambridge, Massachusetts, has transferred its headquarters to the administration offices of the New York Zoological Society in the New York Zoological Park, New York City. The new executive committee consists of Childs Frick, *chairman,* Harold J. Coolidge, Jr., Warren Kinney, Dr. John C. Phillips and Laurance Rockefeller. Dr. W. Reid Blair succeeds Harold J. Coolidge, Jr., as executive secretary. There have been additions to the advisory board, which is made up as follows:

Thomas Barbour, for the Museum of Comparative Zoology; Frederick R. Burnham, for the California Academy of Sciences; Charles M. B. Cadwalader, for the Academy of Natural Sciences of Philadelphia; James L. Clark, for the Camp Fire Club of America; Harold J. Coolidge, Jr., for the American Society of Mammalogists; W. Redmond Cross, for the New York Zoological Society; Stanley Field, for the Field Museum of Natural History; Frank B. Foster, for the Philadelphia Zoological Society; Childs Frick, for the American Museum of Natural History; Joseph Grinnell, for the Museum of Vertebrate Zoology, University of California; William P. Harris, Jr., for the Museum of Zoology, University of Michigan; Edward House, for the Carnegie Museum; Edward Mallinckrodt, Jr., for the Washington University, St. Louis; John T. McCutcheon, for the Chicago Zoological Society; Robert T. Moore, for the California Institute of Technology; John C. Phillips, for the American Wildlife Institute; Kermit Roosevelt, for the National Association of Audubon Societies; Dean Sage, Jr., for the Boone and Crockett Club; Rodolphe M. de Schauensee, for the Wilderness Club; Alexander Wetmore, for the Smithsonian Institution.

The American committee will continue to operate independently as heretofore, and this transfer of the office to new quarters in the New York Zoological Park will in no way affect the status or continuing policies. The committee has recently issued its ninth publication, the title of which is "The Organization of Nature Protection in the Various Countries," by G. A. Brouwer.

SCIENTIFIC NOTES AND NEWS

THE Franklin Medals awarded annually by the Franklin Institute, Philadelphia, "to those workers in physical science or technology, without regard to country, whose efforts have done most to advance a knowledge of physical science or its applications," have been awarded to Dr. William Frederick Durand, professor emeritus of mechanical engineering at Stanford University, and to Dr. Charles A. Kraus, professor of chemistry and director of research in chemistry at Brown University. The medal is being awarded to Dr. Durand "in recognition of his notable achievement as pioneer in laboratory research and the theory of aeronautics, and of his diversified and distinguished contributions to the science of hydrodynamics and aerodynamics, particularly to the advancement of the theory and development of aircraft propellers," and to Dr. Kraus "in recognition of his numerous and fundamental research in chemistry and electrochemistry, particularly, his valuable contributions to the knowledge of reactions in liquid ammonia, of the chemical behavior of metals, and of the properties of electrolytic solutions." The medals will be presented at the annual Medal Day exercises of the institute, which will be held on May 20.

THE 1937 Warren Triennial Prize of the Massachusetts General Hospital, amounting to five hundred dollars, which was founded in 1867 by the late Dr. J. Mason Warren in memory of his father, has been awarded to Dr. Henry K. Beecher, anesthetist at the Massachusetts General Hospital, for a manuscript entitled "The Physiology of Anesthesia."

THE Addingham gold medal for humanitarian services has been awarded to Dr. Béla Schick, attending physician at Mount Sinai Hospital, New York City, known for his work on immunity to diphtheria and for the discovery of the Schick test. The award is given annually by trustees of a fund provided by the late William Hoffman Wood of England. It is made to the individual who has made "the most valuable discovery for relieving pain and suffering in humanity." Presentation will be made *in absentia* by the Lord Mayor of Leeds, since Dr. Schick is unable to go abroad for the ceremonies.

THE medal of the Ulster Irish Society was presented to Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, at the annual dinner of the society, which was held on April 22. Dr. Henry Noble MacCracken, president of Vassar College, made the presentation.

THE James Watt International Medal of the British Institution of Mechanical Engineers has been awarded to Henry Ford. The medal is awarded every second year to commemorate the birth of James Watt, inventor of the steam engine, in 1736.

THE Halley lecture of the University of Oxford will be given on June 16 by Professor A. O. Leuschner, director of the Students' Observatory of the University of California. He will speak on "The Hecuba Group of Minor Planets." Among Americans who have been Halley lecturers in previous years are: Drs. William Wallace Campbell, Harlow Shapley, Henry Norris Russell and Edwin Powell Hubble.

THE doctorate of science will be conferred in July by the University of Bristol on Dr. Charles Galton Darwin, since 1936 master of Christ's College, Cambridge. He was previously, from 1923 to 1936, professor of natural philosophy at the University of Edinburgh.

DR. W. L. BRAGG, Cavendish professor of experimental physics at the University of Cambridge, formerly director of the National Physical Laboratory, has been elected to a professorial fellowship at Trinity College.

DR. T. WINGATE TODD, professor of anatomy of the School of Medicine of Western Reserve University, has been elected president of the American Association of Physical Anthropologists.

AT the annual meeting of the American Society for Experimental Pathology, the following officers were elected: *President,* Dr. Morton McCutcheon; *Vice-president,* Dr. Ernest W. Goodpasture; *Secretary-Treasurer,* Dr. Paul R. Cannon; *Councilors,* Dr. Shields Warren and Dr. Jesse L. Bollman. The next meeting of the society will be held in Toronto in conjunction with the meetings of the Federation of the American Societies for Experimental Biology.

DR. ROBERT HUTCHISON has been elected president of the Royal College of Physicians, London, in succession to Viscount Dawson of Penn.

LIEUTENANT-COLONEL J. H. M. GREENLY, a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research and chairman of the British Non-Ferrous Metals Research Association, has been appointed president of the British Institute of Fuel, in succession to Sir Philip Dawson.

AFTER spending the winter in Havana, Cuba, Dr. Charles Wardell Stiles, formerly zoologist in the U. S. Public Health Service, has returned to Florida, but because of continued failing health has found it necessary to resign from the winter faculty of Rollins College.

DR. RALPH LINTON, of the University of Wisconsin, has been appointed professor of anthropology at Columbia University, and Dr. George Herzog has been appointed assistant professor. Dr. Linton has been visiting professor at Columbia during the present year.

DR. LOUIS LEON THURSTONE, since 1924 professor of psychology at the University of Chicago, has been designated Charles F. Grey Distinguished Service Professor. He succeeds Dr. Charles H. Judd, who has held the chair since 1929 and who will retire as head of the department of education in July.

DR. RUSSELL L. CARPENTER, assistant professor of anatomy at the College of Physicians and Surgeons of Columbia University, has been appointed professor of zoology at Tufts College, to take the place of Dr. Herbert V. Neal, whose retirement in June was announced recently.

DR. WILTON M. KROGMAN, of Western Reserve University, has been appointed associate professor of physical anthropology and anatomy at the University of Chicago.

M. ROBERT COURRIER has been appointed professor of experimental morphology and endocrinology at the Collège de France.

RALPH E. WILSON, formerly secretary of the department of meridian astronomy of the Carnegie Institution of Washington at Dudley Observatory, Albany, has been appointed a member of the staff of the Mount Wilson Observatory. His work at Pasadena will begin in May.

DR. E. W. GUDGER, bibliographer and associate curator of ichthyology in the American Museum of Natural History, has been retired with the rank and title of honorary associate in ichthyology. He will remain at the museum to complete the Dean Memorial Volume and will continue his research and writing there.

THE Board of Trustees of the American Medical Association has appointed Dr. E. V. Cowdry, professor of cytology, Washington University, St. Louis, representative of the association for the Commission on Standardization of Biological Stains.

DR. ELMER O. KRAEMER has resigned as a member of the experimental staff of the du Pont Company at Wilmington Del., a position which he has held since 1927. He has received from the Lalor Foundation an award of $2,500 to facilitate the continuance of his studies of the size and shape of giant molecules. His investigations will be carried out at the University of Uppsala in the laboratory of Professor The Svedberg. He also plans to visit the principal research centers for physical and colloid chemistry in Europe.

LLEWELYN WILLIAMS, curator of economic botany at the Field Museum, Chicago, has been granted leave of absence for two years to engage in special work for the Ministry of Agriculture of Venezuela. Mr. Williams will assist Dr. Henry F. Pittier, the Swiss botanist, who was at one time connected with the U. S. Department of Agriculture, in a botanical survey and study of the various resources of Venezuela. He will make his headquarters at Caracas.

THE fourth of the Elihu Root lectures on the influence of science and research on current thought, a series organized by the Carnegie Institution of Washington in honor of Mr. Root, long the chairman of its board of trustees, was given on April 19 by Dr. F. H. Seares, assistant director of Mount Wilson Observatory. His subject was "The Concept of Uniformity."

PROFESSOR FRANZ WEIDENREICH, of Peiping, China, will give an address before the New York Academy of Sciences at eight o'clock on the evening of May 6. His subject will be "The Phylogenetic Relationships of Sinanthropus with Special Reference to the Dentition." The discussion will be led by Drs. William K. Gregory, Milo Hellman, J. H. McGregor, George Pinkley and Harry L. Shapiro.

DR. FREDERICK SLOCUM, professor of astronomy and director of the Van Vleck Observatory, Wesleyan University, will give the graduate convocation address at Brown University on the occasion of the semi-centennial anniversary of the establishment of graduate work on June 18. He will speak on "Intellectual Curiosity."

DR. VILHJALMUR STEFANSSON, the Arctic explorer, gave a lecture at Duke University on April 13 on "Diet in Primitive People." On April 14 Dr. Harold W. Brown, professor of preventive medicine and public health at the University of North Carolina, lectured on "Hookworm."

THE Smith Chapter of the Society of the Sigma Xi held its annual meeting and dinner on April 14 at Chapin House. One active member and ten associates were initiated. Following the dinner Dr. George D. Birkhoff, Perkins research professor of mathematics and dean of the School of Arts and Sciences at Harvard University, gave a lecture on "Mathematics and Philosophical Thought." The officers for the year 1938–1939 elected at this time are as follows: *President,* Dr. Myra M. Sampson, professor of zoology; *President-elect,* Mr. Robert F. Collins, associate professor of geology; *Secretary,* Dr. Lois T. Slocum, assistant professor of astronomy, and *Treasurer,* Dr. Deane Montgomery, assistant professor of mathematics.

IN a recent note in SCIENCE, based on cable dispatches to the daily press from abroad, giving a list

of scientific men who were said to have committed suicide in Vienna, the name of Professor Waldemar Denk, head of the second Surgical Clinic of the University of Vienna, was included. Dr. Denk writes "I am very glad to assure you that I am in the best of health and working without any interruption in my hospital."

NOMINATIONS for the Theobald Smith award in the medical sciences should be sent by June 1 to the office of the Permanent Secretary of the American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. The award was established by Eli Lilly and Company, "to recognize demonstrated research in the field of the medical sciences, taking into consideration independence of thought and originality." It consists of the sum of $1,000 and a bronze medal and is made to an investigator who is under thirty-five years of age. Any fellow of the association, except members of the Award Committee, may submit to the Permanent Secretary's office in Washington, D. C., the name of a proposed recipient of the award with full data regarding his personality, training and research work.

THE Union of American Biological Societies has received a grant of $10,000 from the Carnegie Corporation of New York through the Carnegie Foundation for the Advancement of Teaching toward support of the educational program of the union. The Committee on Biological Science Teaching of the union which is in charge of the project consists of Oscar Riddle, *chairman,* E. V. Cowdry, F. L. Fitzpatrick, H. Bentley Glass, Benjamin C. Gruenberg. Dr. D. F. Miller, associate professor of zoology of the Ohio State University, has been given leave of absence for several months and during this period his full-time services have been secured by the committee.

THE American Association of Anatomists celebrated the fiftieth anniversary of its founding at its annual meeting at the University of Pittsburgh, which was held from April 14 to 16 in conjunction with the annual meeting of the American Association of Physical Anthropologists. A special program was presented by past presidents of the society as follows: Dr. Ross G. Harrison, Yale University, "Factors Concerned in the Development of the Ear"; Dr. Robert R. Bensley, University of Chicago, "Plasmosin: An Important Constituent of Protoplasm"; Dr. Clarence M. Jackson, University of Minnesota, "Nature of Abnormally Rapid Increase in Body Weight Following a Period of Growth Suppression"; Dr. Florence R. Sabin (with Dr. Austin L. Joyner), the Rockefeller Institute, "Tuberculous Allergy without Infection"; Dr. George L. Streeter, the Carnegie Institution, Baltimore, "Origin of the Gut Endoderm in Macaque Embryos"; Dr. Charles R. Stockard, Cornell University Medical College, "Structural Disharmony: The Genetic and Developmental Independence of the Upper and Lower Jaws."

UPON the invitation of the Italian Government, the United States, through the State Department, has appointed delegates to the tenth International Congress of Chemistry, to be held in Rome from May 14 to 21. C. C. Concannon, chief of the Chemical Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, has been named chairman. The other delegates are: Edward Bartow, Norman Bekkedahl, M. T. Bogert, H. A. Gardner, Thomas Midgley, Jr., W. A. Noyes, Sr., C. L. Parsons, Alexander Silverman, W. W. Skinner, J. W. Turrentine and E. R. Weidlein. The National Research Council and the National Academy of Sciences, responding to the invitation of the organizing committee of the congress, as their representatives at the thirteenth meeting of the International Union of Chemistry (under the auspices of which the congress meets) have appointed the following councilors: Edward Bartow, vice-president of the International Union of Chemistry, head of the delegates, and M. T. Bogert, Alexander Silverman, James F. Norris, C. L. Parsons and Robert E. Swain. The delegates are: Ross A. Baker, Norman Bekkedahl, H. K. Benson, Gustav Egloff, Colin G. Fink, S. C. Lind, Thomas Midgley, Jr., Arthur Scott and E. R. Weidlein. Alternates are: Emma P. Carr, John V. N. Dorr, J. B. Ekeley, J. C. Hostetter, W. L. Jennings, R. E. Montonna, W. A. Noyes, Jr., Atherton Seidell and J. W. Turrentine.

DISCUSSION

FORCE IN MECHANICS

I WANT to add the following comments to J. W. Campbell's criticism (SCIENCE, November 12, 1937) of W. F. Osgood's "Mechanics":

In connection with the writing of Newton's second law of motion in the form $F = kma$, Professor Campbell says, "Whether or not it is the best way is a matter of taste." It seems to me that more is involved here than a matter of taste—questions of consistency of notation, simplicity of mathematical expressions of physical laws and the significance of the symbol m are involved.

The arguments used for introducing an arbitrary constant into Newton's law are equally valid for writing $A = kwl$ for the area of a rectangle; because the width and the length may be measured in feet, for

example, while the area may be required in acres. To be consistent those who write $F = kma$ should write $A = k\pi r^2$ for the area of a circle, $P = k\frac{W}{t}$ for power, and so on for all geometrical and physical magnitudes. If this procedure were consistently followed, equations of physics would be so overloaded with various sorts of k that KKK would look relatively sane.

Newton's second law is based on the fact that the force applied to a body is proportional to the acceleration produced; it is written $F = ma$. Here m is the constant of proportionality; it is a physical property characteristic of the body. The case is similar to that of Hooke's Law, $F = kl$, where l is the elongation produced by the force F when applied to an elastic body. In this case also the constant of proportionality is a physical property of the body. There is no more reason for writing $F = kma$ than for writing Hooke's law as $F = k'kl$, kinetic energy as $E = \frac{1}{2}kmv^2$, etc.

The term "centrifugal force" has been a stumbling block to the student of mechanics, and a source of confusion to authors of mechanics and physics.[1] Professor Osgood realizes this and, after using the term, makes the following remarks:

> Why, then, the term "centrifugal force"—the force that "flees the centre"? The explanation is a confusion of ideas. If the mass is held in its path by a string fastened to a peg at the centre, O, does not the string tug at O in the direction OP away from the centre and is not this force exerted by the particle in its attempt, or tendency, to fly away from the centre? The answer to the first question is, of course, "Yes." Now one of the standard methods of the sophists is to begin with a question on a non-controversial point, conceded without opposition in their favor, and then to confuse the issue in their second question—"and is not this force exerted by the particle?"
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> *Matter can not exert force,* for a *force* is a *push* or a *pull,* and matter can neither push nor pull; it is inert. The particle does not pull on the string, the string pulls on the particle. . . .
>
> And now, after all is said and done, comes the rejoinder: "But the particle *did* pull on the string, for otherwise the string would not have pulled on the peg." There is no answer to these people. Some of them are good citizens. They vote the ticket of the party that is responsible for the prosperity of the country; they belong to the only true church; they subscribe to the Red Cross drive—but they have no place in the Temple of Science—they profane it.

I do not qualify as a "good citizen" under any of these criteria; yet I find the rejoinder reasonable. If the string pulls on the particle, but the particle does not pull on the string, then Newton's third law does not hold at the junction of the string and the particle! If matter does not exert force, what does? Are we to understand that the string, which exerts force, is not matter?

The confusion springs from the use of the word *force* to denote the effect as well as the cause of acceleration. A particle has no acceleration when the vector sum of the forces acting on it is zero; yet a particle in uniform circular motion does have an acceleration, although the sum of the centripetal and the "centrifugal" forces is zero. This apparent contradiction is due to applying the term *centrifugal force* to something which is not a force.

It is worth noting here that persons who use the term *centrifugal force* do not use an analogous term—say, *ab-fugal* (away fleeing) *force*—in discussing motion in a straight line. If there is a centrifugal force in circular motion, because the string which connects the particle to the peg is under tension, there must be an *ab-fugal* force when a particle is given an acceleration by pulling at it by means of a string, likewise under tension.

If a centrifugal force is not a force, what is it? As this question is fully discussed in the third edition of my "Analytical Mechanics" (p. 148, *ff*) I will not take space to answer it.

Commenting on the advice to the student to "Isolate the system," Professor Osgood says, "The man who first uttered these words deserves a *monumentum aere.*" The idea underlying these words has great pedagogical value. Professor Osgood deserves credit for emphasizing it. But it seems to me that the choice of these words is unfortunate. The idea can be better expressed in different words. There is no isolated system in nature, and no natural system can be isolated. Instead of, apparently, asking the student to do the impossible, the instructor should encourage the student to recognize the interactions between systems and between bodies in a system. The student should be trained to focus his attention, in a given problem, on one system or on one body, and then to consider the actions to which it is subject.

In order to compare the relative advantage of expressing the same idea in terms of one or the other terminology, let us consider uniform circular motion of a particle. When the student is told to isolate the particle, Newton's first law will flash into his mind and warn him that an isolated particle moves in a straight line without acceleration—not in a circle with acceleration. When he is told to apply the forces which will make the particle move in a circle, he will apply to the particle a force directed towards the center. Then the argument, "But the particle *did* pull on the string," will present itself, and he will put in another force directed away from the center. Thus the student becomes the victim of the use of abstract and ambiguous words. If, on the other hand, he is told to focus his attention on the particle, to see what bodies are acting

[1] *Cf.* Hertz's "Principles of Mechanics," p. 5.

on it and then to represent their actions by force-vectors, neither the mental conflict nor the confusion about the number of forces involved is likely to appear.

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EFFECT ON ROOT FORMATION OF RETREATING CUTTINGS WITH GROWTH SUBSTANCES

RECENT studies on the effect of growth substances on root formation have shown that an initial basal treatment with these substances is effective in inducing roots on many plants which are difficult to root. This initial treatment usually consists of soaking the bases of the cuttings in .01 to .05 per cent. water solutions of these substances for about twenty-four hours. There are, however, many plants, such as grapefruit and the sweet orange, which respond very little or not at all to such an initial treatment. Cuttings of these plants may show some callus formation at the basal cut surface within three to four weeks after the treatment, but initiate no, or very few roots. It has been found, however, that by retreating such cuttings at varying periods after the initial treatment more roots are formed than by an initial treatment only. In an experiment with Hamlin sweet orange cuttings, the untreated lot produced no roots after six weeks in a propagating frame with bottom heat; cuttings initially treated with .02 per cent. indole-3-acetic acid produced one to two roots; and cuttings retreated three weeks after an initial treatment, three to six roots. The data when tested according to student's method show odds of 4,999 to 1 that the difference indicated between initial treating only and retreating is due to the treatment and not to chance variation. Similar results from retreating have been obtained with papaya and Camellia cuttings. Experiments with other plants are now in progress, including avocado and mango, which have not responded to initial treatments with the usual growth substances.

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NEW FOSSIL LOCALITIES IN THE DURHAM TRIASSIC BASIN

T. R. JONES in 1862[1] noted the presence of *Estheria ovata* (Lea) and of ostracoda near Egypt, N. C., in that part of the Deep River Triassic Area now known as the Cumnock Basin. He referred the octracoda, which had been described by Emmons and others as "Cyprides," "Cytheres" and "Bairdias" to the genus *Candona*(?) and erected the species *rogersii*. Prouty in 1928[2] delimited the Durham Triassic Basin as that portion of the Deep River Area lying northeast of Sanford, N. C., and in 1931[3] reported the presence therein of fresh-water crustacea at a single locality approximately three quarters of a mile west of Nelson, N. C. The crustacea, one a phyllopod *Estheria ovata* (Lea), the other a smooth-shelled ostracod belonging to the family Cypridae, occur in a fine, dark-red micaceous and carbonaceous shale.

During the spring of 1937, two previously unreported fossil localities were discovered within the Durham Basin. One half of a mile west of Lowe's Grove, N. C., on State Highway 54 there occurs a fine, white to brown, yellow-mottled, slightly metamorphosed shale containing *Estheria ovata* (Lea) and smooth-shelled ostracoda of the Cypridae family. One quarter of a mile east of the same village on State Highway 54 there occurs a fine, dark-red, carbonaceous shale containing a similar fauna.

The ostracoda of the Lowe's Grove localities, as well as those of the Nelson locality, seem to represent a single species and should probably be referred to *Candona ? rogersii* Jones.

The Lowe's Grove Beds are certainly equivalent in age to the Nelson Beds. In agreement with Prouty the writer believes the fossiliferous shales of the Durham Basin can be correlated with the Cumnock Formation of the Cumnock Basin to the south and with similar fossiliferous shales of other Triassic Areas of Eastern North America.

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DISTRIBUTION OF REPRINTS OF PAPERS BY THE LATE BASHFORD DEAN

THERE have come to me for distribution reprints of twenty short papers published by Dr. Dean from 190[illegible] to 1912. These comprise mainly biographies, book reviews and articles on fossil fishes, evolution and a few miscellaneous subjects. If those who are interested will look up titles for these years in Dr. Dean's bibliography in Volume I of the Dean Memorial Volume and will indicate their preferences, I will supply these so far as the articles are available. Failure to send desired reprints will mean that these are not available.

I should like to put these reprints in the hands of students—especially the younger men—to whom they might be of value.

E. W. GUDGER

AMERICAN MUSEUM OF NATURAL HISTORY

[1] T. R. Jones, "A Monograph of the Fossil Estheriae," Paleontological Society of London, 1862, p. 123.

[2] W. F. Prouty, Abstract, *Bull. Geol. Soc. Amer.*, 3[illegible] 210–211, 1928.

[3] W. F. Prouty, *Am. Jour. Sci.*, Fifth Series, 21: 1[illegible] 487, 1931.

SOCIETIES AND MEETINGS

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in its historic building on Independence Square, Philadelphia, on April 21, 22 and 23. Members and invited guests to the number of about two hundred were present at the various sessions which began with the scientific program on Thursday morning and ended with the annual dinner on Saturday night. Thirty-eight papers were presented in four sessions, of which eight were in the field of the physical sciences, fifteen in the geological and biological sciences, five in the historical and social sciences and six in the humanities. The general character of the society tends to make the presentation of papers less technical and more generally intelligible than is the case in the more highly specialized societies. Speakers frequently say that they find this feature of the Philosophical Society's meetings a stimulating and clarifying influence, and scholars in many different fields are delighted to learn at first-hand from research students the significant results of their investigations.

Among some of the outstanding astronomical reports given at this meeting should be mentioned the search for trans-Neptunian planets, by V. M. Slipher, of the Lowell Observatory, Flagstaff, Arizona, and a thorough study of the visible features of the planets by his brother, Earl C. Slipher; a Survey of Two Metagalactic Clouds, by Harlow Shapley, of the Harvard Observatory; a continuous motion-picture record of solar phenomena secured with the spectroheliograph, by Robert R. McMath, at the McMath-Hulbert Observatory of the University of Michigan, and the Penrose Memorial Lecture, by S. A. Mitchell, of the McCormick Observatory, of the University of Virginia, on the Eclipse Expedition of 1937.

In physics, Karl K. Darrow, of the Bell Telephone Laboratories, described his important work on the neutral particles, and Arthur J. Dempster, of the University of Chicago, presented the results of his work on the "Isotopic Constitution of the Rare Earth Elements." On recommendation of the research committee and of the council, the society awarded to Professor Dempster the John F. Lewis Prize for 1937 for his outstanding discoveries in mass spectroscopy which were reported at previous meetings of the society and published in its *Proceedings*.

The biological papers were numerous and important and only a few of them can be mentioned specifically. Herbert Fox, of the University of Pennsylvania, presented the results of an extensive research on the occurrence of chronic arthritis in wild mammals; Aleš Hrdlička, of the U. S. National Museum, presented further evidence of the normal growth of the head during adult life; Ralph E. Cleland, of Goucher, College, who received the Lewis Prize last year, reported on his newer work on the chromosomes of the evening primrose, Onagra; Gerhard Fankhauser, of Princeton University, discussed a new and valuable way of demonstrating that supernumerary chromosomes occur in certain vertebrates; Edwin G. Conklin reported that by means of low temperatures the vortical movement of the protoplasm in eggs and embryonic cells could be stopped or disorientated while other processes remained normal; Charles R. Stockard discussed the relations of genetic and endocrine factors in instinctive and reflex behavior; Alexis Carrel described the culture of whole organs in the Lindbergh apparatus; E. Newton Harvey, A. E. Loomis and Garret Hobart demonstrated with moving pictures the localization of electric potentials over the human brain, by means of a new form of apparatus; Davenport Hooker described the origin of the grasping movement in the human embryo.

Among the historical and economic papers especial mention should be made of one by Albert T. Volwiler, of Ohio University, upon his study of the hitherto unpublished correspondence and memoranda of President Benjamin Harrison and his Secretary of State, James G. Blaine; one by Edward S. Corwin, of Princeton University, on the relations of Secretary Stanton and President Johnson, and another by William E. Lingelbach, of the University of Pennsylvania, on Belgian Neutrality *vs.* Alliances. S. W. Boggs, geographer of the U. S. State Department, reported upon the map of Latin America as established by treaties, and William H. Hobbs, of the University of Michigan, presented the results of his extensive search of the records of early discoveries of Antarctica, proving that American whalers discovered a portion of that continent, which was named for its discoverer "Palmer's Land," several years before it was seen by any other explorers; John C. Merriam, president of the Carnegie Institution of Washington, described the historical research and preservation of historical remains at St. Augustine, Florida, which is being carried on by the Carnegie Institution.

Several important papers in anthropology, archeology, philology and literary history were given on Saturday morning. Among these should be mentioned: an ethnic map of Australia, showing the locations of some 5,000 tribes, by D. Sutherland Davidson, of the University of Pennsylvania; an account of English antecedents in Virginia architecture, by Thomas T. Waterman, architect of the U. S. Government; a paper on the documentary value of ancient vases, by George H. Chase, of Harvard, and one on archeology and astronomy, by William Bell Dinsmoor, of Columbia University; Franklin Edgerton, of Yale, in a paper on etymology and interpretation maintained that "one must always interpret a word in accordance with its conventional meaning," rather than its etymology; Gilbert Chinard, of Princeton, pointed out the great

influence of classical Greek and Latin histories and orators on the men who shaped American institutions, and in particular Polybius seems to have been drawn upon; J. S. P. Tatlock, of the University of California, pointed out some of the important motives for the writing of the "Historia Regum Britanniae," by Geoffrey of Monmouth.

At the executive session of the society on Friday morning, the following officers were elected for the ensuing year:

President: Roland S. Morris.
Vice-presidents: Edwin G. Conklin, Robert A. Millikan, Cyrus Adler.
Secretaries: John A. Miller, William E. Lingelbach.
Curator: Albert P. Brubaker.
Treasurer: Fidelity-Philadelphia Trust Company.
Executive Officer: Edwin G. Conklin.

And the following were elected councilors to serve until 1941:

William F. Albright, Arthur L. Day, Frank A. Fetter, Harold C. Urey.

Twenty-five residents of the United States were elected as resident members and five foreign members were elected, *viz.:*

Members

Class I—Mathematical and Physical Sciences

Resident

Carl D. Anderson, Pasadena, Calif.
William David Coolidge, Schenectady, N. Y.
Frederick Gardner Cottrell, Washington, D. C.
Frank Baldwin Jewett, Brantwood, N. J.
Frederick George Keyes, Cambridge, Mass.
John von Neumann, Princeton, N. J.

Foreign

Paul Adrien Maurice Dirac, Cambridge, England.

Class II—Geological and Biological Sciences

Resident

Karl Spencer Lashley, Cambridge, Mass.
John Howard Northrop, Princeton, N. J.
Francis Bertody Sumner, La Jolla, Calif.
David Hilt Tennent, Bryn Mawr, Pa.
Donald Dexter Van Slyke, New York, N. Y.
George Hoyt Whipple, Rochester, N. Y.

Foreign

Edgar Douglas Adrian, Cambridge, England.
Archibald Vivian Hill, London, England.

Class III—Social Sciences

Resident

James Truslow Adams, New York, N. Y.
Nicholas Murray Butler, New York, N. Y.
Edward Hopkinson, Jr., Philadelphia, Pa.
Charles Howard McIlwain, Belmont, Mass.
Harold Glenn Moulton, Washington, D. C.
Oliver Mitchell Wentworth Sprague, Boston, Mass.
Joseph Henry Willits, Philadelphia, Pa.

Foreign

Charles Rist, Versailles, France.
Harold William Vazeille Temperley, Cambridge, England.

Class IV—Humanities

Resident

Campbell Bonner, Ann Arbor, Mich.
C. F. Tucker Brooke, New Haven, Conn.
Frederick Paul Keppel, Montrose, N. Y.
Henry Carrington Lancaster, Baltimore, Md.
Benjamin Dean Meritt, Princeton, N. J.
Charles Rufus Morey, Princeton, N. J.

The social features of the general meetings of the American Philosophical Society are especially pleasant. As in previous years, out-of-town members and speakers at the sessions were guests of the society at the Benjamin Franklin Hotel, which is only four squares distant from the hall and luncheon was served in the hall each day of the meeting. On Thursday evening the council of the society was entertained at the hospitable home of Mr. and Mrs. J. Bertram Lippincott. Following dinner the annual meeting of the council was held. On Friday evening a special dinner for the guests of the society at the Benjamin Franklin Hotel was served before the Penrose Memorial Lecture. Following the lecture there was a general reception. On Saturday evening the annual dinner of the society was held in the Bellevue-Stratford Hotel and some two hundred members and invited guests were present. After dinner addresses were given by Professor George H. Parker, of Harvard; Hu Shih, the distinguished Chinese philosopher, and Professor J. S. P. Tatlock of the University of California.

On Saturday afternoon the members and their guests were taken on an excursion up through the beautiful Wissahickon Valley to the country residence of Mr. John Story Jenks, where they were shown the notable beautiful plantings, trees, shrubs and flowers. They were then taken to the Morris Arboretum of the University of Pennsylvania which is in the immediate vicinity and where there are collected a very representative assemblage of all the trees and shrubs that will grow in this climate. This feature of the annual meeting was an unusual one and was highly appreciated by all who took part in it.

These social features of the general meetings of the American Philosophical Society are notable and in some respects unique. The society has always been known for its hospitality and for the spirit of comradeship among scholars in all fields of learning. The sessions in the historic hall of the society on Independence Square are held amid memorials of the founders of the Republic and the great scholars of this and other lands and in an atmosphere of dignity and charm that is unexcelled in this country.

DR. E. G. CONKLIN

SPECIAL ARTICLES

THE LARVAL DEVELOPMENT OF DRAGONFLIES OF THE GENUS AESHNA

THE Odonata of the genus *Aeshna* (also spelled *Aeschna*) are among the largest dragonflies and are cosmopolitan in distribution. Their larval (nymphal) development has been studied in recent years by Walker (1912), Wesenberg-Lund (1913), Portmann (1921), Münchberg (1930) and Lucas (1930), but the statements of these authors concerning the number of instars through which a given species passes and the length of its larval life are somewhat at variance.

The youngest material which Walker[1] (pp. 46–47) had was a nymph of *Ae. canadensis,* 10.5 mm long, in which the wing-cases were barely indicated by a pair of minute buds. "Beginning with this stage the nymph apparently moults eight times before emerging as the adult insect, there being eight instars, including the full-grown nymph. Judging by the size of the egg and the relative sizes of the known instars it appears probable that there are three or four ecdyses in addition to those observed, making a probable total of twelve or thirteen stages. . . . It is possible that the number varies . . . in *Aeshna* but I am inclined to believe that the number of stages in a given species is constant." On the length of nymphal life he wrote: "Our knowledge of the nymphal life of *Aeshna* is not sufficient to warrant a positive statement as to its length, which indeed is not necessarily the same in all species, nor in every locality. It is, however, exceedingly probable that in southern Canada and the northern United States three years is the normal length of life of *Ae. canadensis* and *Ae. umbrosa,* if not of all the species found there . . . it seems very probable that in *Ae. canadensis* the imago appears in the third season after the egg is deposited." (pp. 49, 50).

Wesenberg-Lund,[2] from observations on oviposition and comparison of larvae observed every eight to fourteen days in ponds in Denmark, concluded that larvae of *Aeshna grandis* hatched in late May from overwintered eggs and that these transformed into imagos three years later after having lived *as larvae* over three successive winters (pp. 380–381); that *Ae. isosceles* has a larval life of one to two years; that *Ae. viridis* may have normally a larval life of two years and that the other species of the genus are probably like *grandis* (p. 382). Wesenberg-Lund's conclusions have been dealt with at length by Münchberg and will not be discussed further here.

Portmann[3] took larvae of *Aeshna cyanea,* 17 mm long, and reared them at Basle, Switzerland, between January and June, under higher than normal temperatures and with abundant food supply. Although it was not possible to maintain a constant temperature, one of his larvae moulted six times, the sixth moult yielding the imago. The combined length of the last five larval instars totalled 95 days, the antepenultimate instar, in which the winter rest occurs under normal conditions, being reduced to 25 days. "The larval life of *Aeshna cyanea* lasts 26 months with us in nature. The young larvae of 17 mm experimented with were from 7 to 8 months old at the beginning of the experiment and developed into imagos in six additional months by optimal rearing. The larval period of the experimental animals lasted only 14 months instead of 26. The entire development of *Ae. cyanea* in nature requires three years but would extend through only 23 months, consequently not quite two years, under the influence of food and heat. Moreover, neither the eggs nor the youngest larval stages were exposed to these optimal conditions" (p. 37, translated). Portmann expresses no opinion as to the number of larval moults.

Münchberg[4] reared *Aeshna viridis* and *Ae. mixta* from eggs to imagos in a laboratory, in Schwerin, Germany, "in order to fix the number of moults and of stages." Omitting the prolarval (pronymphal) stage, he lists 12 larval moults for *viridis* and 10 larval moults for *mixta,* the last moult in each case respectively yielding the imago (pp. 188, 189). The number of individuals of these two species reared is not stated. He designated the larval stages of *Ae. viridis* by the capital letters A, B, etc., to M inclusive, larval stage A terminating with the first larval moult, stage G with the seventh larval moult, and so on.

To determine the length of larval life of Aeshnine (and presumably other Odonate) larvae, Münchberg, following Wesenberg-Lund, rejected the method of rearing in the laboratory for that of collecting, measuring and comparing larvae in nature at frequent intervals throughout four years. Assuming that the earlier larval stages of all the European species of *Aeshna* reach the length of 12 mm at the conclusion of stage G (seventh larval moult), as his reared *viridis* did (p. 193), he compared his material of this and other species collected at frequent intervals and referred them, according to total length, width of the seventh abdominal segment and the point on the abdomen to which the external, or posterior, wing sheaths reach, to the corresponding stages of *viridis.* The observed dates of oviposition and of collection of larvae referred to stages A to L enable him to formulate the length of larval life. Briefly stated, his results for northeastern Germany are as follows:

[1] University of Toronto Studies, Biological Series, No. 11, pp. viii, 213, 28 pls., 1912.

[2] *Int. Rev. gesamt. Hydrobiol. u. Hydrog.,* 6(2/3): 155–228, (4/5): 373–422, 1913.

[3] "Die Odonaten der Umgebung von Basel." Inaugural Dissertation, pp. 103, 3 taf., Lörrach, 1921.

[4] *Zeitschr. f. Morph. u. Oekol. der Tiere,* 20 (1): 172–232, 1930.

Aeshna grandis, mostly two years, but in peat bogs of Breitebruch three years (p. 198), from overwintered eggs.

Ae. viridis, in non-peaty ponds two years as a rule (p. 203), in a peat brook, separated from the ponds by only a few hundred meters, more often three years (p. 204), from overwintered eggs (p. 201).

Ae. cyanea, two years as a rule, from overwintered eggs (p. 207).

Ae. subarctica, four years as a rule, three years as a minimum, from probably overwintered eggs (p. 210).

Ae. mixta, one year, from overwintered eggs (pp. 211–214).

Lucas,[5] largely on the basis of earlier work by East, lists 12 ecdyses for *Aeshna cyanea* in captivity in England, but adds: "Probably the first moult immediately after hatching is omitted and possibly the next also." On the supposition that eggs overwintered and hatched in the spring, the dates given indicate that larval life occupied perhaps 14 months (pp. 51–52). East, he says, "succeeded in making certain that it requires two seasons to reach maturity; but individual specimens sometimes develop abnormally at a slower rate, and it seems clear that there is not quite absolute fixity in the matter. As regards the first winter we are uncertain, and possibly the eggs laid in the autumn may remain dormant during that period and hatch in the spring. It may be, however, that the earlier laid eggs hatch in the autumn, the late ones in the spring, and this may account for irregularity in size at the same date in this and other species that have a long life as imagines; for emergence of *Ae. cyanea* usually commences late in June or early in July, while egg-laying may take place during August, September, and even October."

In view of the gaps and divergences in the development of the insects described in these preceding accounts, it is of interest to state briefly the results obtained from rearing four individuals of *Aeshna tuberculifera*, a North American species, from egg to, or almost to, imago. This species, known from Maine, Ontario and Wisconsin south to Connecticut, New York and Indiana, had not been recorded from Pennsylvania previous to the writer's taking ten males and two females at Smithson's Pond, near Cheyney, Delaware County, Pennsylvania, on five days, September 8 to 27, 1935. One of the females was taken pairing, brought home alive and on the following day (September 16) laid eggs in a leaf of cat-tail (*Typha*). Three lengths of *Typha* leaf containing the oviposition punctures were placed in a jar containing some water, some of the punctures being below, some above, the water's surface. The jar, the three pieces of leaf and water, the last renewed at intervals, were kept in my study, a moderately heated room, and examined from time to time during the winter. On March 13, 1936, the first living, active larva was found in the water. Between this date and April 5, 85 larvae were obtained. I attempted to rear 33 of them, the remainder being used for other purposes. Two of these transformed to imagos on July 27 and August 3, 1937, respectively, both males, the former as its *thirteenth* larval moult, the latter as its *fifteenth* larval moult. Two female larvae died, without transforming, on June 7 and July 17, 1937, respectively, both of them having completed fourteen larval moults; had they lived to adulthood each would, of course, have made at least one more moult.

Each larva of *tuberculifera* was reared in a separate container by the methods employed for *Anax junius* (Calvert 1929).[6] The conditions under which these four, and other shorter lived, *tuberculifera* were kept appear to have been identical, so that the differences in the number of moults do not seem to be due to environment.

A detailed account of these larvae of *tuberculifera*, their growth and development, is in preparation by Miss Elsie Lincoln.

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[5] "The Aquatic (Naiad) Stage of the British Dragonflies (Paraneuroptera)." Ray Society, No. 117, pp. xii, 132, 35 pls., 1930.

[6] *Proc. Am. Phil. Soc.*, 68 (3): 227–274, 1929.

A PHYSIOLOGICAL STUDY OF THE RIND COLOR OF CERTAIN CITRUS FRUITS

DURING the course of an investigation of the physiological effects of ethylene on citrus fruits in Florida it was noted that carotenoid pigments were present in the rinds of limes, lemons and grapefruit which were mature but still green. This would ordinarily not be considered unusual, since carotenoids are known to be present in green oranges though masked by the presence of chlorophyll. It is significant, however, that these plastid pigments diminish in quantity, and sometimes disappear, as the light-colored citrus fruits attain full color. The above is true, whether the fruit be degreened by ethylene or permitted to degreen on the tree. This is illustrated in Tables 1 and 2.

TABLE 1

CAROTENOID CONTENT OF THE RIND OF GREEN-COLORED AND ETHYLENE-DEGREENED CITRUS FRUITS OF SIMILAR MATURITY

Variety	Mature green (Control)		Degreened with ethylene	
	Carotene (mgs per 100 gms fresh peel)	Xanthophyll (mgs per 100 gms fresh peel)	Carotene (mgs per 100 gms fresh peel)	Xanthophyll (mgs per 100 gms fresh peel)
Villa Franca lemon	.085	.830	.030	.360
Grapefruit (Duncan type).	.150	1.040	.075	.510
Persian limes ...	.180	1.850	.055	.470
Perrine lemons ..	.065	.670	.025	.275
Key limes	.100	1.090	.095	.480

TABLE 2

CAROTENOID CONTENT OF THE RIND OF MATURE GREEN AND TREE-DEGREENED (FULL-COLORED) CITRUS FRUITS

Variety	Mature green		Degreened on tree (Full colored)	
	Carotene (mgs per 100 gms fresh peel)	Xanthophyll (mgs per 100 gms fresh peel)	Carotene (mgs per 100 gms fresh peel)	Xanthophyll (mgs per 100 gms fresh peel)
Villa Franca lemon	.085	.830	.060	.275
Grapefruit (Duncan type) .	.045	.435	.004	.000
Persian limes ...	.045	.500	.010	.000
Perrine lemons ..	.065	.670	.020	.160
Key limes	.100	1.090	.055	.310

Recently Zechmeister[1] and Tuzson have shown that in the determination of carotenoids in orange peel the epiphasic petroleum ether layer contains mostly cryptoxanthin. However, since cryptoxanthin has not been reported in limes, lemons and grapefruit, the conventional method of expressing the results as carotene and xanthophyll is employed for this type of fruit.

Most of the yellow substances in the rind of the full-colored limes, lemons and grapefruit were washed out of the extract by the dilute sodium carbonate solution which is employed to remove the flavone pigments. Schunck[2] reported that the yellow pigment in the lemon rind consisted principally of a water-soluble pigment together with the acid derivatives of two xanthophylls. From the context it is evident that the author referred to ripe lemons. Hardy and Warneford[3] noted "the almost entire absence of chromoplasts in the rind cells" of limes but apparently did not analyze the green fruit. These authors reported that the color was due to the presence of a phlobatannin and stated that in this respect the lime resembles the lemon and grapefruit.

The above results are in striking contrast to those found in the analysis of orange rinds in the present investigation. Carotenoids are present in the rinds of mature green oranges, and they increase as the fruit ripens. Inasmuch as a more detailed report will appear elsewhere only one example is presented here (Table 3). These analyses were made while the fruit was still green in color but legally mature according to state and federal standards, when it was yellow (just before commercial picking), and again about two months after the fruit of the adjoining trees had all been picked for the market.

If the underlying cause for this phenomenon were known it might help explain the great variation in color of citrus fruits grown in different sections of the country or even in different sections of the same state.

TABLE 3

CAROTENOID CONTENT OF THE RIND OF PARSON BROWN ORANGES DURING RIPENING

Date sampled	Rind color	Sugar/acid ratio of juice	Total carotenoids (mgs per 100 gms fresh peel)
September 28 ..	Near* Parrot green	9.38	1.045
December 1	Yellow ochre	14.64	2.470
February 1	Near Ochraceous orange	27.50	5.340

* Ridgway's Color Chart.

[1] L. Zechmeister and P. Tuzson, *Berichte der deutschen chemischen Gesellschaft*, 69 (8): 1878–1884, 1936.

[2] C. A. Schunck, *Proc. Roy. Soc. London*, 1903: 165–176, 1904.

[3] F. Hardy and F. H. S. Warneford, *Indust. and Eng. Chem.*, 17 (1): 48–50, 1925.

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DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES
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THE MOLECULAR WEIGHTS OF UREASE, CANAVALIN, CONCANAVALIN A AND CONCANAVALIN B[1]

THE jack bean, *Canavalia ensiformis*, contains four crystallizable globulins, urease, canavalin, concanavalin A and concanavalin B. The first of these is an enzyme, while the third is a hemagglutinin. In this paper we describe briefly the determination of the molecular weights of these four globulins. The results and methods used will be given in a later publication.

Urease was prepared from jack-bean meal; some was recrystallized once and some twice. We centrifuged six preparations of varying degrees of purity in the Svedberg ultra-centrifuge. All preparations contained a main constituent with a sedimentation constant of approximately 19×10^{-13}, and one preparation was nearly free from impurity.

Determination of the diffusion constant for urease was especially difficult because the urease became opalescent upon standing even at 0° and eventually precipitated from solution. However, by dissolving in neutral phosphate containing a mixture of $NaHSO_3$ and Na_2SO_3 the urease was stabilized and we were able to determine the diffusion constant as well as the partial specific volume.

Crystals of concanavalin A, concanavalin B and

TABLE I

Protein	$s_{20} \times 10^{-13}$	$D_{20} \times 10^{-7}$	Partial specific volume	Molecular weight
Urease	18.6	3.46	0.73	473,000
Canavalin	6.4	5.1	0.73	113,000
Concanavalin A ...	6.0	5.6	0.73	96,000
Concanavalin B ...	3.49	7.4	0.73	42,000

[1] From the Institute of Physical Chemistry, The University, Upsala, Sweden.

canavalin were likewise obtained from jack-bean meal and were twice recrystallized. The sedimentation constants of these proteins were obtained by using the ultra-centrifuge. The diffusion constants and partial specific volumes were determined also. Table I gives values for the sedimentation constants, diffusion constants and partial specific volumes as well as the molecular weights calculated for all four jack-bean globulins.

We wish to express our appreciation to Professor The Svedberg for the use of his laboratory, and the senior author wishes to acknowledge his indebtedness to the Guggenheim Foundation for the grant which made this work possible.

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SOME EFFECTS OF ANDROSTERONE ON SEXUAL DEVELOPMENT IN THE FEMALE RAT

THE production of intersexuality in the female rat by the ante-natal administration of testosterone and testosterone propionate has been reported.[1, 2] These findings have been confirmed in the mouse by Raynaud,[3] and partially confirmed in the rat by Hamilton and Gardner.[4] Intersexual changes in genetic female chickens have been produced by Willier[5, 6, 7] and others by injecting testosterone, androsterone and dehydro-androsterone into the incubating eggs.

Androsterone[8] in divided doses has been administered to female rats during different periods of pregnancy. Thirteen litters have been delivered to date. The total amount of androsterone administered in each case varied from 40.0 mg to 280.0 mg. At least one female new born from each litter has been killed and examined under a dissecting microscope. The remaining animals are still alive and will be examined after maturity. Of the 23 new born examined, bilateral persistence of Wolffian duct derivatives was found in seven cases, unilateral persistence in three cases. The vas deferens in these animals lies adjacent to and parallel with the uterus. No definite evidence of Mullerian duct inhibition has been found to date. In a few animals the gonads have been displaced caudally, and development of the ovarian capsule is inhibited. Study of serial sections has confirmed these findings and revealed efferent tubules continuous with the rete of the gonads and continuing into the epididymis. The latter is continuous with the vas deferens, which communicates with the urethra in the normal male position. Seminal vesicles and prostatic diverticula are present. The caudal portion of the vagina is absent, and the cranial portion has bilateral connections with the urethra medial to the orifices of the ejaculatory ducts.

The degree of masculinization seems to be dependent not only on the total quantity of androsterone administered, but also on the periods of pregnancy when treatment is given.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

METHYL METHACRYLATE AS A LABORATORY TOOL[1]

CERTAIN physical and chemical properties of polymerized methyl methacrylate[2] adapt it to many services in the laboratory. As is well known, this material has the power to conduct light; it is elastic; it does not break if dropped; it can be turned in a lathe, cut with a saw and polished by buffing. Although it can be ignited, combustion is slow and gentle, not violent as it is in the case of celluloid. Heated to a temperature of 130° C. it does not melt, but becomes plastic so that it can be molded or shaped; it will retain its new form after chilling in cold water. It is insoluble in water, and quite or nearly insoluble in ethyl alcohol, amyl acetate or xylene. On the other hand, it is readily soluble in chloroform.

A rod of methyl methacrylate will conduct light with but little loss, even if sharply curved. It may be tapered or machined on a lathe or slow-moving emery wheel. Rough surfaces may be smoothed with a file or sandpaper, and a coating of the plastic, dissolved in chloroform, applied to such surfaces. As soon as the chloroform has evaporated a comparatively smooth

[1] R. R. Greene and A. C. Ivy, SCIENCE, 86: 2226, Aug. 27, 1937.
[2] R. R. Greene, M. W. Burrill and A. C. Ivy, *Proc. Soc. Exp. Biol. and Med.*, in press, February, 1938.
[3] A. Raynaud, *Compt. Rend. Soc. de Biol.*, 126: 866, December, 1937.
[4] J. B. Hamilton and M. U. Gardner, *Proc. Soc. Exp. Biol. and Med.*, 37: 570, December, 1937.
[5] B. H. Willier, T. F. Gallagher and F. C. Koch, *Proc. Nat. Acad. Sci.*, 21: 625, 1935.
[6] B. H. Willier, T. F. Gallagher and F. C. Koch, *Physiol. Zool.*, 10: 101, 1937.
[7] B. H. Willier, SCIENCE, 86: 409, November 5, 1937.
[8] Crystaline androsterone has been furnished through the courtesy of Dr. Ernst Oppenheimer of Ciba Co. This investigation has been supported in part by a grant from the Macy Foundation.
[1] This work was aided by a grant from the Williams 1900 Fund.
[2] This plastic is sold by E. I. du Pont de Nemours and Company, under the trade name of Lucite.

surface will be obtained which may be brought to a high polish by buffing with very fine carborundum powder. For some purposes this material offers a convenient and inexpensive substitute for quartz rods, such as were used by Knisely,[3] in illuminating the organs of living animals. The apparatus described below furnished enough illumination for microscopic observation but has not been tried as a light source for the taking of motion pictures. Without the addition of cooling devices it seems probable that the heat evolved from more intense light sources would soften the end of the rod to such an extent as to limit its usefulness. This aspect is being investigated. The writer has used the concentrated filament of a 50 c.p. automobile lamp as a light source, drawing power from a Voltrol transformer connected with 110 volt A.C. circuit. The lamp was supplied with a metal housing, containing a circular opening through which a rod could be inserted. The end of a methyl methacrylate rod of one half inch diameter, placed one eighth of an inch away from the lamp, captured sufficient light to furnish strong illumination at the other end, the light being intensified if the distal end had been tapered to a diameter of about one quarter of an inch. This illuminated tip, placed under the web of a frog's foot or under the frog's kidney or lung, furnished enough light to enable one to view the circulation of the blood in the vascular system. A rod of one inch diameter was also used with excellent results. One end was tapered to a diameter of one half inch, and the surfaces polished by buffing. The larger end of the tube was inserted in the lamp housing about one eighth inch away from the lamp, the other end was provided with a short rubber sleeve. One end of a rod 12 inches long and one half inch in diameter was rounded and polished; the other end was bent at a right angle, near the tip. When the rounded end was slipped into the rubber sleeve, a flexible joint was formed. Since the rounded surface of the small rod remained in contact with the end of the large rod, the free tip could be moved to diverse positions without serious loss of illumination.

Whenever the rod was bent at right angles or where it was tapered abruptly, there was some loss of light. The application of powdered aluminum did not remedy this difficulty, since the aluminum powder absorbed a noticeable amount of light. Chinese white or French chalk mixed with a chloroform solution of the plastics and applied at the angle conserved some of the light. Fortunately the light transmitted is more than adequate for routine observations through the microscope even when the angle of the rod is not painted with reflecting materials.

A methyl methacrylate rod was also used to direct light upon an object to be viewed, by reflected light, under the hand lens or binocular microscope. In making difficult dissections such a rod was used to illuminate the particular area under dissection.

A dioxane solution of methyl methacrylate made an excellent quick-drying label varnish, suitable for pencil or ink-written labels. There was a slight tendency for typed labels to "run."

This same solution served as an excellent water-white mounting medium in place of balsam or dammar. Unlike balsam it showed no tendency to turn yellow with age. It dried more quickly than either balsam or dammar. It appeared to have no harmful effect on the usual stains. Slides were stained, run up the alcohol series and placed in a mixture of equal parts of chloroform and xylene. Because of the high volatility of the solvent, sections of the tissue were covered promptly with the mounting medium after the slide was removed from chloroform-xylol. The index of refraction of this plastic is 1.50–1.52, and the visibility of sections mounted in it was entirely satisfactory.

Tubes varying in diameter from 1½ inches to 6 inches, having a wall thickness of ⅛ inch, may be secured,[2] and from these cylinders of varying height may be cut, by use of a fine-toothed saw. A cylinder or ring was attached to a plate of methyl methacrylate to form a box, the edges being coated with a chloroform solution of the plastic to insure fusion. (At present it is difficult to secure polished plates at a moderate price, but the writer has been assured by the manufacturers that this will be possible in the near future.) A specimen preserved in formalin or in glycerine was placed in such a container and the cover sealed on by use of chloroform. Two small holes were then drilled in the cover: one to serve as an air port, the other as an inlet through which additional preserving fluid was forced by means of a hypodermic syringe. To allow for changes in the volume of the solution at different temperatures, it was found necessary to leave a small bubble of air in the chamber. The two minute openings were then sealed with paraffin. When glycerine was used, the openings were sealed with litharge (mono lead oxide) with which the glycerine formed a hard cement. Methods of trapping the air bubble so that it will be inconspicuous are being attempted.

Such containers possess features which adapt them for use not only for museum specimens, but also for delicate specimens which are to be handled by students. They are not easily broken, for the material is tough and elastic. Once sealed the container is a single unit, since the chloroform causes an actual fusion of the separate pieces used. The visibility is high; the specimen can be viewed from all angles.

[3] M. H. Knisely, *Anat. Rec.*, 64: 499–523, 1936.

Evaporation of the preserving fluid is reduced to the minimum. The cost of a container made of this plastic is far less than an equivalent glass container. As soon as polished plates of methyl methacrylate can be secured at a low cost, it will be easy to prepare containers of rectangular form by cementing the sides and ends in the manner described above for cylindrical containers.

Hibben[4] has reported that it is possible to embed biological materials in this plastic. However, Knight[5] pointed out that the process is by no means simple. The solubility of methyl methacrylate in chloroforms suggests that it might be possible to embed rather large objects in a solution of this plastic without recourse to polymerization of the monomethyl methacrylate. However, the writer has so far been unable to secure entirely satisfactory results, due chiefly to excessive shrinkage and the inclusion of air bubbles. The addition of xylene to a chloroform solution of the plastic gives better results and offers an attractive field for further experiment.

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A SIMPLE FEEDER FOR RATS AND MICE

CONTROLLED feeding of dry foodstuffs in nutrition experiments on rats and mice presents several technical difficulties. For exact work the usual wire hopper method is useless, while pastes are subject to infection by moulds and they introduce errors from evaporation.

We have designed a feeder meeting the following demands: (1) The amount must be exactly and quickly ascertainable; (2) enough food to satisfy the appetite must be readily available; (3) soiling of food by urine and feces must be prevented; (4) introduction of extraneous matter, such as sawdust, from the cage must be minimized; (5) the fondness of the animals for eating by holding the food in the front paws should be given scope; (6) the container should be easily filled, weighed and emptied when necessary; (7) it should be cheap and easily made.

We utilized a tall cylindrical tin-can (height, 6½ inches; diameter, 3 inches) having a removable lid. Two platforms were fixed inside the can (these were made from discarded fruit tins) and a rectangular entrance-hole was made in the side. This hole was just large enough to accommodate the head and shoulders, together with the front paws, and we found it convenient to make the hole by crossed cuts so that the triangles which were formed might be turned inwards. The upper and lower ones helped to support the platforms, while the side ones prevented too much lateral movement of the head and shoulders inside.

The lower platform is perforated, with holes large enough to permit food particles to fall through to the bottom of the can, and it extends inwards to a distance about equal to the length of the animal from the tip of the snout to just behind the shoulder blades. From this innermost edge a vertical partition (unperforated) extends to the bottom of the can and is closely applied to its sides. We made the horizontal and vertical parts in one piece.

The upper platform (unperforated) was fixed above the upper edge of the entrance hole, and it extends almost completely across the can except at the back, where it has a vertical drop-piece, as in the case of the lower platform. This partition, with a "pigeon-hole" in its lower end, extends a short distance (less than the height of the "pigeon-hole") below, and behind the vertical part of the lower section to which it is closely applied. This upper platform acts as a hopper and its efficiency is, of course, increased by having the front edge higher than the back one.

If the entrance hole is properly made the animal has some little difficulty in withdrawing itself, so that it is obliged to drop any food it holds and use its front paws. This food falls through the perforations and is not lost.

To prevent sawdust being swept into the container we suspend it above the floor of the cage and fit a few wire rungs below the entrance hole to provide support for the hind legs and to permit the animal to squat whilst feeding.

We are at present using a dross made up according to the recipe given by Thomson in the *Journal of Hygiene*, 36: 1, 1936, and find it highly satisfactory.

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[4] J. H. Hibben, SCIENCE, 86: 2228, 247–248, 1937.
[5] Henry G. Knight, SCIENCE, 86: 2232, 333–334, 1937.

BOOKS RECEIVED

BARDÈCHE, MAURICE and ROBERT BRASILLACH. *The History of Motion Pictures.* Pp. xii + 412. Illustrated. Norton. $4.00.

MILLER, JOHN A. *Master Builders of Sixty Centuries.* Pp. xviii + 315. Illustrated. Appleton-Century. $3.00.

SMITHSONIAN INSTITUTION. *Explorations and Field Work in 1937.* Pp. 122. 123 figures. The Institution. Washington, D. C.

Stanford University. *Annual Report of the President for the Forty-sixth Academic Year Ending August 31, 1937.* Pp. ix + 550. The University.

THURSTONE, L. L. *Primary Mental Abilities. Psychometric Monographs, No. 1.* Pp. viii + 121. Illustrated. University of Chicago Press. $2.00.

TRATTNER, ERNEST R. *Architects of Ideas; Story of the Great Theories of Mankind.* Pp. 426. 15 plates. Carrick and Evans, New York. $3.75.

VON EULENBURG-WIENER, RENÉE. *Fearfully and Wonderfully Made; the Human Organism in the Light of Modern Science.* Pp. xii + 472. 18 figures. Macmillan. $3.50.